IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Rinze BENEDICTUS et al. Group Art Unit: 1742

Serial No.: 10/642,518 Examiner: J. Combs-Morillo

Filed: August 18, 2003

For: BALANCED Al-Cu-Mg-Si ALLOY PRODUCT

RULE 132 DECLARATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SIR:

I, Alfred Ludwig Heinz, declare as follows:

1. I am currently employed by Aleris Aluminum Koblenz GmbH the assignee of the present application and have the job title of Director of Technology. I have been employed by Aleris Aluminum Koblenz GmbH and its predecessors Corus Aluminium Walzprodukte GmbH and Hoogovens Aluminium Walzprodukte GmbH for 16 years.

2. I have a university degree in Metal Physics from the University of Cologne, Germany; a PhD degree in Materials Science from the University of Aachen, Germany.

3. I am an inventor or co-inventor on a number of US patents. A list of my US patents is attached (ATTACHMENT I). I also have patents outside the US.

4. I am an author or co-author of over 30 publications. A representative list of my publications is attached (ATTACHMENT II).

5. I am a listed co-inventor on the present US application.

6. I am familiar with the present application and the Office action of July 17, 2007 and its rejections of the present claims.

US 5,593,516 to Cassada III

7. I understand Claims 23, 24, 26-30, 32-34, 38-50 and 52-54 are rejected under 35 U.S.C. §103(a) as being unpatentable over Cassada III (US 5,593,516, hereinafter Cassada).

8. Cassada is alleged to teach an aluminum-based alloy sheet (typically 0.40 in. thick (col. 7 line 16) with 2.5% Cu, 0.1 - 2.3% Mg, up to 0.15% Fe, up to 0.10% Si, up to 0.20% Zr, up to 0.05% Ti (Cassada claims 1,2,6) which is said to overlap the presently claimed alloying ranges of Cu, Mg, Si, Fe, Mn and Zr (cl. 23, 38-41, 45, 50, 52-55). The Office Action asserts "[b]ecause Cassada teaches a process of working and heat treating an Al-Cu-Mg alloy that overlaps or touches the boundary of the presently claimed alloying ranges, then it is held that Cassada has created a prima facie case of obviousness of the presently claimed invention."

9. Cassada teaches away from the presently claimed combination of copper and magnesium levels. Its Abstract discloses the alloy consists essentially of 2.5-5.5 percent copper, 0.10-2.30 percent magnesium, with minor amounts of grain refining elements, dispersoid additions and impurities and the balance aluminum. However, the Abstract also immediately thereafter states, "The amounts of copper and magnesium are controlled such that the solid solubility limit for these elements is not exceeded." (Abstract; See also col. 4, first paragraph). The meaning of this control is explained in detail in the disclosure of Cassada and excludes the alloys of the present invention.

10. The control is accomplished by using copper and magnesium only in the portion of Cassada's Figure 1 between the Solid Solubility Limit and the Alloy Composition Lower Limit. These limits are defined by equations disclosed by Claim 1 and col. 4 of Cassada.

Cu max = -0.91 Mg + 5.59; and

Cu min = -0.91 Mg + 4.59.

11. Claim 23 recites 4.3 - 4.9% Cu and 1.5 - 1.8% Mg. Using the present Claim 23 Mg values in the Cassada solubility equations results in the following:

Cu max = -0.91 (1.5) + 5.59 = 4.22%; and

Cu min = -0.91 (1.8) + 4.59 = 2.95%.

12. Thus, for the 1.5-1.8% Mg of present Claim 23, Cassada only permits 2.95 to 4.22% Cu. Thus, Cassada forbids the 4.3-4.9% Cu range of present Claim 23.

13. Present dependent claims have Cu ranges spaced as much or further from those permitted by Cassada's Cu_{max} and Cu_{min} equations:

Dependent Claim 38 recites 4.3-4.6% Cu and 1.5-1.8% Mg.
For this Mg range Cassada only permits 2.95 to 4.22% Cu.

Dependent Claim 39 recites 4.4 - 4.5% Cu and 1.5 - 1.8% Mg.
For this Mg range Cassada's equations only permit 2.95 to 4.22% Cu.

Dependent Claim 40 recites 4.4 - 4.9% Cu and 1.5 to 1.7% Mg.
For this Mg range Cassada's equations only permit 3.04 to 4.22% Cu.

Dependent Claim 41 recites 4.3 - 4.9% Cu and 1.5 - 1.7% Mg.
For this Mg range Cassada's equations only permit 3.04 to 4.22% Cu.

Dependent Claim 54 recites 4.3 - 4.9% Cu and 1.68-1.8% Mg.
For this Mg range Cassada's equations only permit 2.95 to 4.06% Cu.

I understand a new Claim 55 will be added to recite 4.4 - 4.9% Cu and 1.61-1.8% Mg.
For this Mg range Cassada's equations only permit 2.95 to 4.12% Cu.

14. Cassada, cols. 3 and 4 explains why this control is necessary.
"The aluminum-based alloy of the present invention consists essentially of 2.5-5.5 percent by weight copper, 0.10-2.3 percent by weight magnesium, and the balance aluminum, and wherein the total amount of magnesium and copper is such that the solid solubility limit of the alloy is not exceeded."
Col. 3, lines 20-26.

"In one aspect of the invention, the aluminum-based alloy has the major solute elements of copper and magnesium controlled such that the solubility limit is not exceeded. In this embodiment, an alloy is provided having higher toughness than prior art alloys as a result of a lower volume percent second phase (VPSP) due to lower copper content.

It has been discovered that combinations of both high strength and high toughness are obtained in the alloy of the present invention by controlling the range of composition of the solute elements of copper and magnesium such that the solid solubility limit is not exceeded. As a result of this controlled compositional range, an inventive alloy is provided with levels of strength that are comparable with those of prior art alloys but with improved fracture toughness or damage tolerance.

For the inventive alloy, the high strength and high toughness properties are based upon maximizing the copper and magnesium additions such that all of the solute, i.e. copper plus magnesium, is utilized for precipitation of the strengthening phases. It is important to avoid any excess solute that would contribute to the second phase content of the material and diminish its fracture toughness. In theory, the maximum solute level, copper plus magnesium, should be held to this solubility limit. This limit is described in weight percent by the equation:

(1) $Cu_{max} = -0.91(Mg) + 5.59$

Therefore, an alloy containing 0.1 weight percent magnesium can contain 5.5 maximum weight percent copper without producing undesirable insoluble second phase particles. Similarly, at 2.3 percent by weight magnesium, the maximum copper would be 3.5 weight percent.

In practice, the solute levels must be controlled to just below the solubility limit to avoid second phase particles. This level of control must be done as a

result of conventional processing techniques for making these types of alloys. In conventional casting of these types of alloys, microsegregation of copper in the ingot results in local regions of high copper content. If the bulk copper level is close to the solubility limit, these regions will exceed the solid solubility limit and contain insoluble second phase particles."
Col. 3, line 51 - Col. 4, line 27.

15. Moreover, the discussion in Cassada of its Alloy Sample 6 having 4.91 % Cu and 1.61 % Mg (see Tables 2 and 3 of Cassada) teaches away from the 4.3 - 4.9% Cu and 1.5 - 1.8% Mg alloy of present Claim 23. Alloy Sample 6 is probably the closest Cassada example to present Claim 23. Its Cu is just outside the present range and its Mg is within the claimed range. For 1.61 % Mg Cassada's equations result in Cu_{max} 4.12% and Cu_{min} 3.12%. Accordingly, Cassada, col. 8, lines 1-3, states, "Sample 6: Contains excess copper, falls outside of inventive alloy copper range for 1.5 (sic 1.6%) wt. % magnesium alloy. Toughness too low." Likewise, the 4.3-4.9% Cu of present Claim 23 falls outside of the 2.95 to 4.22% Cu inventive range of Cassada permitted for an alloy having the 1.5-1.8% Mg of Claim 23.

16. I understand Claims 56 and 57 are to be added to the present application by an Amendment to be filed with this Declaration and they will recite the following:

> 56. (New) Method according to claim 23, wherein in the alloy the amount of Cu is 4.3 to 4.5%, the amount of Mn is 0, the amount of Mg is 1.6 to 1.7%, the amount of Si is 0.23 to 0.30 %, and the amount of Fe is 0.06-0.10%.
>
> 57. (New) Method according to claim 23, wherein in the alloy the amount of Cu is 4.3 to 4.5%, the amount of Mn is 0, the amount of Mg is 1.6-1.7%, the amount of Si is 0.10 to 0.25 %, and the amount of Fe is 0.06-0.10%.

17. AA2024, AA2525, present alloys 1 and 2 of Tables 1-3, Alloy Sample 6 of Cassada, Claim 23, and new Claims 56 and 57 are compared as follows:

TABLE - Chemical composition, in weight %,

Alloy	Cu	Mn	Mg	Zr	Si	Fe	Ag	Cr
AA2024*	4.4	0.59	1.51	0	0.05	about 0.06	-	-
AA2524*	4.3	0.51	1.39	0	0.05	about 0.06	-	-
1*	4.4	0	1.68	0	0.25	about 0.06	-	-
2*	4.4	0	1.61	0	0.11	about 0.06	-	-
Cassada Alloy Sample 6**	4.91	-	1.61	0.11	0.02	0.01	0.50	-
Present Claim 23***	4.3 - 4.9	-	1.5-1.8	-	0.10-0.40	0<Fe#0.10	-	# 0.15
Present Claim 56***	4.3 - 4.5	0	1.6-1.7	-	0.23-0.30	0.06-0.10	-	# 0.15
Present Claim 57***	4.3 - 4.5	0	1.6-1.7	-	0.10-0.25	0.06-0.10	-	# 0.15

* balance aluminum and inevitable impurities

** V 0%, balance aluminum and inevitable impurities

*** balance essentially aluminum and incidental elements and impurities, which are at most 0.05% per element, 0.15% total

18. Alloy 1 of the present invention, at Table 1 of the present application has no Mn and a high Si level. Page 11 of the present application explains the following:

"From the results of Table 3 it is clear that the lifetime is the better the lower the level of manganese is. By adding silicon the strength levels (as shown in Table 2) increase again while the improvement in lifetime is still considerably high. That means that the improvement in fatigue crack growth rate is significantly higher when manganese levels are low, more or less independent of the level of silicon. That means that those alloys, especially at lower ΔK-values, have a significant longer lifetime and therefore are very useful for aeronautical applications."

19. Table 2 of the present application shows Alloy 2 has unexpectedly high tensile yield strength levels. It is respectfully submitted this is shown by comparing alloys 1 and 2. Alloy 2 is closer to the invention claimed in Claim 56 than is the closest example of Cassada, namely Cassada Sample alloy 6. Thus, it is respectfully submitted comparing the results of Alloy 1 to Alloy 2 is sufficient to show the advantages of the Claim 56 invention over Cassada Sample alloy 6.

20. Alloy 2 is closer to present Claim 56 than Cassada Sample alloy 6 for the following reasons:

Alloy 2 has Cu 0.1% below the upper end of the claimed range. Cassada Sample alloy 6 has Cu 0.41% above the claimed range.

Alloy 2 and Cassada Sample alloy 6 both lack Mn.

Alloy 2 and Cassada Sample alloy 6 have the same Mg.

Alloy 2 has no Zr (and thus is closer to the impurity level of Claim 56) while Cassada Sample alloy 6 has 0.11% Zr to be above the impurity level.

Alloy 2 has 0.11% Si which is higher than the 0.02% level of Cassada Sample alloy 6 and thus closer to the 0.23% Si lower level of Claim 56.

Alloy 2 has 0.06% Fe which is higher than the 0.01% level of Cassada Sample alloy 6 and thus closer to the 0.06% Fe lower level of Claim 56.

Alloy 2 and Cassada Sample alloy 6 both lack Cr.

Alloy 2 has no Ag (and thus is closer to the impurity level of Claim 56) while Cassada

Sample alloy 6 has 0.50% Ag to be above the impurity level. This Ag is an important aspect of the Cassada disclosure. Cassada, col. 5, lines 32-41 says strength increases if silver is added. Moreover, the effect of Ag is shown by comparing Cassada Table 2 alloy samples 3 and 4 which are similar but for Ag levels. Cassada Table 3 shows the silver adds strength to the alloy sample 4 in the T651 temper. In contrast, present Alloy 2 and the present claims do not permit Ag. Thus, this further implies present Alloy 2 is closer to the present invention than Alloy sample 6 of Cassada.

21. Alloy 1 has higher Mg and higher Si than Alloy 2. However, Alloy 1 has unexpectedly better tensile yield strength levels than Alloy 2, as shown in Table 2, due to the increased level of Si in Alloy 1. Page 7 mentions that "Magnesium also provides strength to the alloy product." However, the difference in Mg is only 0.07% from a base of 1.61% and is too small to be the driving force to the increased tensile yield strength levels of Alloy 1 shown in Table 2 of the present application. In contrast, the 0.25% Si of Alloy 1 is more than double the 0.11% Si of Alloy 2.

22. Table 3 of the present application shows present Alloy 2 has a significant unexpected improvement in fatigue crack growth rate over the "baseline" AA2024 alloy which has 4.4 % Cu and 1.51 % Mg (Si of 0.05%). Present Alloy 2 having 4.4% Cu and 1.61% Mg (Si of 0.11%) is outside the 3.12-4.12% Cu range permitted by Cassada's equations for a 1.61% Mg alloy. The "baseline" AA2024 alloy is also outside the 3.22-4.22 % Cu range permitted by Cassada's equations for a 1.51% Mg alloy, but is closer to the respective permitted Cassada Cu range than is present Alloy 2.

23. As explained at page 11 of the present application, from the results of Table 3 it is clear that the lifetime is the better the lower the level of manganese is. By adding silicon the strength levels (as shown in Table 2) increase again while the improvement in lifetime is still considerably high. That means the improvement in fatigue crack growth rate is significantly higher when manganese levels are low, more or less independent of the level of silicon. That also means those alloys, especially at lower ΔK-values, have a significantly longer lifetime and therefore are very useful for aeronautical applications.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Date: January 14, 2008

By: Alfred L. Heinz

Alfred Ludwig Heinz

ATTORNEY DOCKET NO. APV31645

ATTACHMENT I - List of US patents of Alfred Ludwig Heinz

	PAT. NO.	Title
1	6,406,567	Stress relieving of an age hardenable aluminium alloy product
2	6,277,219	Damage tolerant aluminum alloy product and method of its manufacture
3	6,159,315	Stress relieving of an age hardenable aluminum alloy product
4	5,803,997	Manufacture of thick aluminum alloy plate
5	5,772,800	Aluminium alloy plate and method for its manufacture